

## **Tackling Wolf Management's Thorniest Issue: The Ecological and Social Complexities of Lethal Control**

A Wolf Conservation Discussion Panel, co-hosted by Pacific Wolf Coalition & University of Washington's School of Environmental and Forest Sciences (October 29<sup>th</sup>, 2014)

Catherine H. Gowan, Carol Bogezi, John M. Marzluff, and Aaron J. Wirsing

The presence of gray wolves (*Canis lupus*) evokes intense emotions and attitudes throughout the species' range (Lute et al., 2014, Treves and Karanth, 2003). Not surprisingly, therefore, the return of the gray wolf to the Pacific Northwest has thrilled conservationists but has often been challenging for citizens, especially hunters and livestock producers, who share turf with these carnivores. In Washington State, wolf recolonization has heightened urban-rural divisions and complicated management efforts to satisfy diverse stakeholders, including conservation groups, livestock producers, and hunters. Thus far, two packs in Washington have repeatedly depredated livestock and in response have been targeted with lethal control. In 2012, the Wedge Pack was removed for depredating cattle and in 2014, the breeding female of the Huckleberry Pack was removed after the pack depredated 24 sheep. Both uses of lethal control were controversial and led to extensive public comment, highlighting the need for scientific data to inform the use of lethal control as a management tool.

Understanding the social and human acceptability of the presence and management of predators is vital to their conservation in a human-dominated world. Although approximately 64% of Washington State residents are in favor of wolf recovery (Responsive Management, 2014), the wolf debate remains intense and management decisions are under heavy scrutiny.

Approximately 63% of Washington residents support some level of lethal removal to protect livestock, while 28% are opposed (Responsive Management, 2014). Residents' values concerning wolves often determine their attitudes toward wolf recovery and the management of wolves in the State. In a survey of Washington residents' attitudes towards wolves, respondents whose views of wildlife were either focused solely on utilization or open to multiple views of

nature and conservation were less accepting of wolf recovery than other value orientation types (Dietsch et al., 2011). In general, residents living in the eastern half of the State were less supportive of wolf recovery and more in favor of lethal control of wolves, whereas most residents in the western half of the state were in favor of wolf recovery and less in favor of lethal control of wolves. These divergent values and management priorities have made wolf management in Washington a contentious topic. The Washington Department of Fish and Wildlife (WDFW) is consequently in the position of resolving wolf conflicts that are based as much, if not more, on social values than the physical effects of wolves.

Conflicts between humans and wolves are more aggravated by human values, perceptions, and attitudes towards wolves than by economic losses stemming from wolf depredations (Treves and Bruskotter, 2014; Dickman, 2010). At the same time, there is growing concern that management actions aimed at reducing the impacts of predators like wolves on humans interests (e.g., predation on livestock and wild game) could disrupt the social behavior and/or alter the ecological role of these top predators (Wallach et al., 2009; Ordiz et al., 2013). Thus, reconciling the interests of wolf conflict mitigation and conservation requires understanding the social dynamics of both wolves and humans. Fortunately, Washington State is in the early stages of wolf recolonization efforts and can draw upon a growing body of research on the ecology and behaviors of wolves in the wild as well as human dimensions of wolf recovery conducted in other states to inform its own management strategy.

To this end, on October 29<sup>th</sup>, 2014, University of Washington Professors John Marzluff and Aaron Wirsing and the Pacific Wolf Coalition hosted a panel discussion of scientists researching issues surrounding one of wolf management's most controversial aspects – lethal control of wolves. The purpose of this panel discussion was to understand some of the complexities of lethal wolf removal, both social and ecological, in order to inform Washington's wolf management policies with the best natural and social science available. This effort involved panelists from a wide range of disciplines and life experiences where wolves and people have had extensive interactions. The panelists included: Dr. Scott Brainerd, from the Alaska Department of Fish and Wildlife (ADFG); Dr. Douglas Smith, from Yellowstone National Park;

Dr. Robert Wielgus, from Washington State University; Dr. Jeremy Bruskotter, from Ohio State University; and Dr. Adrian Treves, from the University of Wisconsin-Madison.

Dr. Scott Brainerd is the Research Coordinator for the Interior and Northeastern Arctic Region of the Division of Wildlife Conservation with ADFG in Fairbanks, Alaska. He has done extensive research on the impacts of breeder loss on wolf pack social structure in Alaska and Scandinavia. His studies highlight the importance of breeding wolves in maintaining group unity at the pack level.

Dr. Douglas Smith is a senior wildlife biologist for the National Park Service in Yellowstone National Park, Wyoming, and has studied wolf biology for over 30 years. He has co-authored multiple papers studying how human-induced mortality of individual wolves affects wolf social dynamics and connectivity.

Dr. Robert Wielgus is an associate professor and the director of the Large Carnivore Conservation Lab at Washington State University in Pullman, Washington. He has done extensive research on the impacts of hunting and lethal control on cougars in Washington State. Most recently, he has been studying the effects of lethal control of wolves as means of reducing livestock depredations.

Dr. Jeremy Bruskotter is an associate professor in the School of Environment and Natural Resources at Ohio State University in Columbus, Ohio. His research areas include natural resources and recreation conflicts and the use of psychology and communication theories in natural resource management and policy.

Dr. Adrian Treves is an associate professor at the University of Wisconsin–Madison in Wisconsin. His research has focused primarily on public attitudes toward wolves and wolf policy in Wisconsin, behavioral ecology of carnivores and the risks for people living near them, and methods for mitigating human-wildlife conflicts.

## Overview of Wolves in the Pacific Northwest

The purpose of the panel was to inform wolf management actions in Washington State. Thus, we began with an up-to-date overview of wolf management in Washington and the surrounding recovery area. Dr. Donny Martorello, from the WDFW, provided some local context, covering current wolf policy in Washington and Oregon, and Carter Niemeyer, retired U.S. Fish and Wildlife Service (USFWS), covered the broader recovery area and the current wolf population and harvest numbers in Montana, Idaho, and Wyoming. Dr. Martorello is the Carnivore Section Program Manager at the WDFW and he has been at the forefront of assessing the status and management of wolves in Washington since their recovery in 2008. He currently oversees much of the ecological recovery and management of wolves in Washington.

Dr. Martorello began the session by giving a brief history of what the WDFW has been doing since wolves arrived in Washington State. In 2007, prompted by the eminent likelihood of wolves recolonizing the state in the next few years, the WDFW Director appointed a 17 member citizen advisory group (the Wolf Working Group or WWG) to advise the development of a state wolf management plan. In addition to the WWG, the WDFW received almost 65,000 public comments on the draft plan and held 23 public meetings around the State for input into the wolf plan. The plan went through a rigorous scientific peer review process. The WDFW Commission approved the Wolf Management and Conservation Plan in 2011 (from here forward referred to as the Wolf Plan). The Wolf Plan is the policy document used to recover and manage wolves in Washington State. Components of the Wolf Plan that involve lethal control of wolves are not implemented in the western two-thirds of the state where wolves are federally listed.

In 2013, the WDFW created the Wolf Advisory Group (WAG) to help inform management and guide implementation of the Wolf Plan. The WAG has been asked to review and recommend conflict-reducing strategies and they are also the review board for livestock compensation programs. It is comprised of a diverse group of stakeholders appointed by the WDFW Director. For 2013-2014, there were nine members representing: Quad-county commissioners, the Farm Bureau, Washington Cattlemen's Association, Cattle Producers of Washington, Conservation Northwest, Humane Society of the United States, Wolf Haven International, Sierra Club, and Hunter's Heritage. The population trend of wolves in Washington is on the rise, going from one

confirmed pack in 2008 to 16 confirmed packs in 2014. The WDFW has been capturing and instrumenting wolves with GPS collars to enable monitoring and assessment of their recovery progress. Washington is seeing a pattern similar to that observed in many Northern Rocky Mountain States (NRM); namely, relatively high wolf population growth rates, with less than 20% of the wolf packs depredating livestock. Two depredation events, mentioned previously, have occurred in northeastern Washington, resulting in the removal of eight total wolves. In both incidents, the WDFW implemented lethal removal of the problem wolves, in accordance with the Wolf Plan (page 80). The WDFW has a checklist for non-lethal preventive measures to be followed before lethal control efforts are considered. The checklist is composed of the following five preventive non-lethal tools that livestock owners are advised to implement before lethal control is used: removing livestock carcasses, removing sick and/or injured livestock, securing bone yards, calving or lambing away from wolves, and hazing wolves if they are encountered. These preventive non-lethal tools are required before WDFW implements any lethal control action on wolves, but it is only recommended that they be in place before depredations occur (Appendix, Figure 1).

In 2008, WDFW began allocating resources toward hiring conflict-specialists, employees acting as liaisons between the WDFW and landowners on wildlife conflict issues, for every region, setting up a compensation program for livestock loss due to wolves, and entering into cooperative, cost-share agreements with livestock owners to implement preventative measures (known as depredation prevention cooperative agreements). Thus far there are 13 conflict specialists (Appendix, Figure 2) working with livestock owners and the general public in areas with the highest level of wildlife conflict (either predator or elk and deer related conflict). There are currently 28 active damage prevention cooperative agreements in the state. These agreements can provide funds for improved fencing, sanitation, guard animals, range riders, and other preventative measures.

Dr. Martorello also presented a snapshot of the Oregon Wolf Management Plan on behalf of Russ Morgan, the Oregon Department of Fish and Wildlife (ODFW) Wolf Program Coordinator. The ODFW developed a wolf conservation and management plan in 2005 and updated it in 2010. As in Washington, there was extensive public input on the wolf management plan, and a Wolf Advisory Group consisting of 14 members who represent its primary stakeholder groups

oversees its implementation. The recovery trends are similar to Washington State and the NRM States. With 10 packs and about 64 wolves, the wolves in Oregon are recovering successfully and the ODFW expects to reach their recovery objective of 4 successful breeding pairs for three consecutive years by 2015. As of 2013, there was an addendum to the wolf plan with new rules on the use of lethal control and harassment of wolves: the new rules set the bar at four qualified depredations by the same pack over the course of six months before lethal control can be considered. Livestock owners must not have unnatural attractants and must implement one non-lethal measure before a depredation will be considered qualified. It is mandatory for ranchers to implement at least one non-lethal wolf control measure as part of their animal husbandry (including removal of any possible wolf attractants including dead animals and any calving afterbirth remains) at least seven days prior to and on the day of the depredation (ODFW Wolf Plan, 2010). In Oregon, when a depredation is suspected, the livestock operator must then implement at least one non-lethal site-specific measure before any additional depredations are considered qualified for potential lethal action against the wolf pack. If the livestock operator implements appropriate non-lethal measures for a period of six months and three depredations by the same wolf or wolf pack occur, ODFW will assess whether the offending wolf or wolf pack will continue depredating, regardless of increased implementation of non-lethal measures. After this assessment lethal control may be qualified. In addition to these new rules, the ODFW is making an effort to be as transparent as possible, using the agency website (<http://www.dfw.state.or.us/wolves/>) to post information about preventative measures, depredation investigations, and pack locations and timelines.

### Wolf recovery in the Northern Rocky Mountain (NRM) recovery areas

Carter Niemeyer has been a primary player in wolf recovery since wolves were first reintroduced in Yellowstone. He is retired from the USDA Wildlife Services, and US Fish & Wildlife Service (USFWS) in Idaho where he worked from the mid-1980s until 2006. Mr. Niemeyer was part of the team that captured and reintroduced the wolves in Yellowstone National Park and Idaho in 1995/1996. He gave a summary of events in the broader recovery area and the wolf population trends and harvest numbers in Montana, Idaho, and Wyoming from 1982 to 2013. Recovery in the NRM was achieved in 2002, and currently there are at least 1691 wolves and 320 packs. In

most NRM states wolf populations have remained stable and are federally delisted, with the exception of Wyoming whose limited state regulation to protect wolves outside of Yellowstone National Park, has resulted in re-listing their wolf population as endangered. Mr. Niemeyer emphasized that the use of non-lethal management tools is not mandatory, except for the consideration of lethal control, in most states, Washington included, and consequently is not readily implemented by many producers. However, by all biological measures the NRM wolf population remains secure under state management and he called gray wolf reintroduction “an amazing success story.”

In summary, numbers of wolves and breeding pairs in Oregon and Washington are increasing steadily, promising the real possibility of achieving the two states’ recovery goals by 2015 and 2021, respectively. Challenges remain in the continued use of the best available science, however, to solve human-wolf conflicts in Washington, as in other western states where wolves are recovering. This discussion panel served to address the difficulties highlighted by Dr. Martorello and Mr. Niemeyer.

### Review of Current Research by the Panelists

Dr. Scott Brainerd based his talk on two recent articles concerning the effects of breeder loss on wolf populations (Brainerd et al., 2008; Borg et al., 2015). The first article, a meta-analysis of 148 breeding wolves in both national parks and unprotected areas, showed that more than half of breeder loss was from anthropogenic causes. The authors found that pups survived in 84% of the cases where breeders were lost, regardless of the sex of the breeder, and that pup survival was better in larger packs (greater than six wolves) where the pups were over six months of age. The loss of both breeders was far more detrimental to reproduction than just the loss of one; 56% of packs that only lost one breeder reproduced subsequently whereas only 9% of packs that lost both breeders subsequently reproduced. Also, relatively few of the packs dissolved after losing one breeder (38.2%), while a much larger proportion dissolved after losing both breeders (>80%). In areas where wolf populations were saturated, it took less time for packs to replace breeders (10 months) than in areas where wolves were recolonizing (~20 months).

Borg et al. (2015) based their article on a 36-year dataset on wolves in Denali National Park where much of the breeder loss was from natural causes, primarily from other wolves. In Denali, breeder loss accounted for 77% of pack dissolution. Interestingly, packs were more likely to dissolve if breeder loss was due to anthropogenic causes than natural ones. However, there was no demonstrable effect of breeder loss on the overall population of wolves in Denali.

Dr. Robert Wielgus presented the results of his research assessing the efficacy of wolf lethal control in preventing livestock depredations using data collected from 1987 to 2012 in Idaho, Montana, and Wyoming (Wielgus and Peebles, 2014). He highlighted the unexpected relationship between lethal control of wolves and livestock depredation rates. Specifically, his team used the annual USFWS wolf harvest reports from 1987-2012 and the United States Department of Agriculture National Agricultural Statistics Service (USDA NASS) records of cattle and sheep depredation counts from wolf occupied counties to determine the correlation between lethal control and livestock depredation incidents. The results of the analysis showed that an increase in livestock, breeding pairs, and wolf numbers was correlated with increased instances of depredation. However, countering common wisdom that wolf removal decreases livestock depredations, Wielgus and Peebles found that there was a 5% increase in depredation (both for cattle and sheep) for every wolf that was killed. This phenomenon is possibly caused by an increase in breeding pairs to compensate for lethal wolf removal (Wielgus and Peebles, 2014). Ultimately, it seems that lethal control might decrease depredation on a local scale, but may not control widespread livestock loss unless over 25% of the wolf population is lethally removed.

Dr. Douglas Smith began his talk by emphasizing that wolves in Yellowstone National Park allow us to study the ecology of these carnivores in an environment mostly free of human interference. Since the reintroduction of wolves into the park in 1995 and 1996, Dr. Smith has been studying pack size and complexity to determine how unexploited packs behave in the wild. Dr. Smith has found that, in the absence of management, wolf packs quickly become socially complex and retain multiple age groups. Having a variety of age groups in a pack is important for the segregation of hunting duties, although not necessarily hunting success (MacNulty et al., 2012; Mech, 1999); females and younger males are faster, while older males are bigger and stronger (MacNulty et al., 2009). In contrast, many of the wolf packs outside of Yellowstone protected area are simple packs composed of breeders and offspring (Smith, *unpublished data*).



Wolf packs are generally composed of primarily younger wolves even in protected areas due to intraspecific strife (Mech, 1994). However, more complex packs are more likely to survive territorial disputes and hunt efficiently than simple packs (Smith, *unpublished data*). Smith and his colleagues are also finding that pups act as social glue for wolf packs; the more pups born to a pack, the less likely it is that subordinate wolves will disperse (Smith, *unpublished data*). In addition, dispersal patterns are seasonally dependent inside Yellowstone National Park, whereas outside the park there is no observable seasonal pattern (Smith, *unpublished data*). At this time, more research is needed to explain why this disparity might exist.

Dr. Smith concluded that it appears that killing wolves reduces social cohesion within a pack. For example, removal of the breeder female was shown to result in higher reproductive rates in a pack due to the breeder male mating with more than one remaining female in the pack. Killing of wolf pups can cause stress in the family pack, and packs whose pups are killed are more likely to disperse than to stay together. Dispersing wolves are more likely to cause livestock conflicts as they find new geographic areas to occupy. In addition, killing wolves may reduce the packs to sizes that cannot efficiently hunt game species and resort to easy prey such as sheep.

Transitioning from the ecological to the social sciences, Dr. Adrian Treves presented his research on common assumptions that lead to lethal removal of wolves. Generally, there are two main justifications for lethal removal of wolves: prevention of property damage and improvement of attitudes towards carnivores (Treves et al., 2009). Dr. Treves believes both of these assumptions need to be evaluated, especially in light of the recent finding by Wielgus and Peebles (2014) that lethal management of wolves is correlated with increased frequency of livestock depredations. One of the ways Dr. Treves studied this issue in Wisconsin was by developing a risk map to determine which areas were most likely to have wolf-livestock conflict. By examining differences between sites with and without depredations, Dr. Treves determined that areas with more grassland and pasture, closer to known wolf pack ranges, and farther from forest coverage were at the highest risk for depredations (Treves et al., 2011). This risk map proved over 90% effective at predicting depredation sites. A highly predictive risk map allows managers to anticipate and plan for, rather than react to, conflicts. Additionally, risk maps can be used to guide local action and reduce the perceived risk of wolf conflicts among residents living close to wolf territories. Dr. Treves found that lethal removal has mixed results in terms of protecting

private property. Namely, he found that the time period between recurring depredations is actually shortened after lethal removal than after use of non-lethal control measures in Michigan (Treves, 2013).

Thus far, lethal removal has also not been found to improve attitudes toward wolves. Treves conducted two surveys of two different citizen panels. The first panel from 2001 was chosen for wolf experience and hunting (Naughton-Treves et al., 2003), the second from 2004 was a random sample (Treves et al., 2009) and both were resampled in 2009. In the years between the surveys, wolf numbers and depredations increased and lethal control of wolves was increased. There was a significant amount of media attention centered on wolf issues. Instead of showing a positive trend in attitudes with increased use of lethal control, a significant portion of citizens became more negative about wolf populations; 37% of respondents reported an increase in the likelihood they would shoot a wolf if they saw it, 44% reported an increased agreement with the statement that Wisconsin's wolf population threatened deer hunting opportunities, and 46-47% of the respondents showed increased agreement to hunting wolves (Treves et al., 2013). On the other hand, support for government sponsored lethal removal increased. Attitudes continued to decline after one year of a public hunting and trapping season (Hogberg et al., 2013). It appears that legalizing the killing of wolves devalued the wolf in the eye of the public in Wisconsin (Treves and Bruskotter, 2014).

Even if attitudes towards wolves on a local scale are becoming more negative in areas where wolves are present, attitudes towards carnivores and other traditionally maligned animals are becoming more positive on a national scale. Dr. Jeremy Bruskotter presented his work on the psychology underlying reactions to large carnivores (Bruskotter et al., 2007; Bruskotter, 2011; Slagle et al., 2013). Dr. Bruskotter (2011) replicated a study by Kellert (1978) surveying the general public about their feelings toward 26 different species of animals. The results showed a marked increase in positive feelings towards wolves; there was a 9% increase of participants indicating they felt "very positively" about wolves and a 3% decrease in respondents who felt "very negatively" about wolves. It is important to study the mental processes, such as perceived risks and benefits and emotional responses, which go into our cognitive construction of animals like wolves because they affect both policy and behavior, potentially leading to intolerance or coexistence. With this in mind, Dr. Bruskotter surveyed readers of an active wildlife blog,

www.thewildlifeneews.com, about their perceived risks and benefits of wolves and their affective responses to wolves. He found that perceived benefits, such as healthier riparian areas, were more predictive of support of wolves than perceived risks, such as dangers to livestock and children, and that there was a large indirect effect of emotional reactions to wolves on perceived benefits (Slagle et al., 2012). In other words, positive feelings towards wolves strongly affect the belief in perceived benefits and subsequent tolerance for wolves. However, negative emotional responses lead directly to intolerance towards wolves, rather than simply an increase in perceived risks (Treves and Bruskotter, 2014). Dr. Bruskotter posited that an individual's perception of wolves is rooted in group identity and membership. Therefore, social conflict must be taken into account when managing wolves. For example, the residents in the NRM can be split into the "new west" (animal rights advocates, environmentalists, conservationists, wildlife advocates) and the "old west" (hunters, gun rights advocates, farmers/ranchers, property rights advocates), and this delineation predicts beliefs about positive impacts of wolves (Bruskotter, *unpublished data*). Because individual perceptions of wolves can be influenced by group membership elite cues, such as a message from an influential member of the community, can have enormous impact on the individuals in the group and shape how they view wolves as well as other groups. In terms of management implications, it is important to focus on shared goals and improvements (rather than just solutions to problems), build trust through cooperative efforts and avoid "demonizing" the other side, and try to avoid power structures that favor some groups over others (Bruskotter, 2014).

### Implications for Washington State

The research findings presented by the panelists can be incorporated into management decisions and help inform future wolf management and conservation strategies in Washington State. The following section will cover the take-away points of the discussion panel and what they mean for Washington State going forward. However, before these specifics, we wish to point out a more general suggestion. The wolf research community is large and scientifically focused. As such, the WAG would benefit from regular consultation with outside scientists, and might consider expanding its membership to include at least one wolf researcher.

A common scientific finding is that lethal management of wolves has many unintended consequences on wolves and human perceptions of wolves. Although Dr. Brainerd's research showed the remarkable resilience of wolves faced with breeder loss, there are still negative effects on wolf packs, such as simplification of social structure, pack dissolution and short-term reproduction decreases, especially when wolves are newly recolonizing an area (Brainerd et al., 2008; Borg et al., 2015). Furthermore, removal of wolves may increase future livestock depredation and has been found to lower the public's valuation of a wolf's life (Wielgus and Peebles, 2014; Treves and Bruskotter, 2014). These findings suggest five lessons Washington managers can apply to minimize human-wolf conflict.

1. Consider the needs of a recolonizing population.

One aspect of Dr. Brainerd's work that is highly relevant for wolf management in Washington is the finding that wolf packs in areas that have already been recolonized and saturated replaced their lost breeders more quickly than wolf packs in recolonizing areas. By implication, wolf packs in areas that have high connectivity with other wolf packs may be more resilient to breeder loss than wolf packs in recolonizing areas (Brainerd et al., 2008, Borg et al., 2015). It is possible, in light of Dr. Brainerd's work, that the shooting of the Huckleberry Pack female breeder in August 2014 will cause the Huckleberry pack to dissolve into solitary sub-adult wolves seeking their own territories. However, the Huckleberry pack's proximity to the wolves in NRM recovery area and Canada will likely diminish the effects of breeder loss because new females can be recruited from nearby packs fairly rapidly. More isolated packs in the central portion of the state, such the Teanaway or Lookout packs, will need to be managed more carefully. Breeder loss may increase the chance of wolves coming into conflict with livestock due to two highlighted mechanisms: (1) either inexperienced young wolves lacking the pack complexity to hunt large ungulates such as elk (Smith, *unpublished*) will prey on sheep, or (2) as a result of compensatory reproduction due to non-breeding females breeding in the absence of the breeder female (Borg et al., 2015). Therefore, unintended consequences of lethal control could include a delay in achieving wolf recovery goals and an increase in livestock conflicts. Wielgus and Peebles (2014) found that 25% of wolves must be removed to decrease livestock

depredation. For wolves in the recovery phase, this percentage is high and if implemented the recovery goals will take longer to achieve and wolves will continue to be federally listed.

## 2. Provide wild space for wolves.

Washington wolf managers may want to consider, as Dr. Smith suggested, what it means to manage for “naturalness” in wolf populations. Between the effects of breeder loss, the tendencies of wolves to form complex rather than simple packs, the importance of key individuals for hunting success, and the unexpected relationship between increased lethal removal and increased livestock depredations (Brainerd et al., 2008; MacNulty et al., 2011; Wielgus and Peebles, 2014), the science is painting a complicated picture for management agencies using lethal control. Given the complexities of managing wolves with lethal control and the risks of such control during the early phases of recolonization (Brainerd et al., 2008; Borg et al., 2015), it would be reasonable to first manage for recovery by allowing wolves sufficient wild space. Washington State is highly populated, however, and while there are wilderness areas that can provide habitat for wolves, they are not as extensive as those in other western states. Consequently, Washington may benefit from a zonal approach that expands on refuges for wolves with management that mimics wild space. These strategic areas could provide extensive protection for wolves, even after delisting, while other areas would allow for more active wolf management (control and/or harvest).

## 3. Develop a predictive map of the risk of human-wolf conflict.

A risk map (see Treves et al. 2011 for an example) of Washington’s wolves showing which ranchers are most likely to experience depredations would be helpful to streamline efforts to work proactively with ranchers. Most ranches, even those with wolf packs in their proximity, do not experience depredations often and as such may not be motivated to enroll in WDFW cooperative agreements or implement non-lethal measures. Livestock producers and WDFW officials could use a risk map to assess whether or not to request extra assistance in implementing non-lethal control. If the rancher is in an area predicting high risk, they may enter into a cooperative agreement or if they are in an area with low risk continue to use their regular predator-prevention measures. In the Q&A session after the presentations, many of the panelists

stressed the need for further scientific studies of the effects of lethal removal and the potential benefits of creating a risk map for Washington.

#### 4. Rethink how lethal control is implemented.

The ecological research on social behavior in wolves (Brainerd et al.; 2008; Borg et al.; 2015; Smith, *unpublished*) provided information that could refine how lethal management is employed in Washington State. Currently, lethal removal of wolves in Washington State is done by USDA Wildlife Services through sharpshooters from helicopters, or by staff on the ground, who find the wolves by following a GPS collared wolf and killing wolves suspected to be problem animals. The age and sex of the wolves are identified after the wolves are shot. Given the current best science on wolf social structure, managers should consider means to allow for selective removal of identified culprits in cases of repeated depredations by the same pack in an area. As this may be extremely difficult, especially in cases where landscape features render individual wolves difficult to identify, the best option may be following Brainerd et al.'s (2008) time and location recommendations for decreasing the impact of lethal removal. It also may be beneficial to revise the requirements concerning non-lethal measure implementation, focusing on designing site-specific preventative plans and making it obligatory to have those plans in place before depredations occur in order to consider lethal removal, similar to the ODFW system (ODFW, 2013). The continued implementation and refinement of the WDFW's conflict specialist program can aid in coordinating with ranchers on pre-depredation preventative measures. In addition, a redefined temporal scale on the wolf-management checklist showing the amount of time non-lethal measures should be in place between depredations before lethal control is employed could provide the time to consider ecologically based management options without the immediate pressure to remove wolves.

With the creation of a risk map, it may also be possible to establish targeted areas with a high probability of livestock depredation where more decisive implementation of lethal removal could be beneficial. However, the work by Brainerd et al. (2008) suggests that, to the extent possible, lethal removal should be limited to solitary individuals and territorial pairs, wolf packs that are large with older pups, wolf packs that are close to other packs, and when it is not breeding season (Borg et al., 2015).

## 5. Understand the human dimension.

Dr. Martorello emphasized that one of the biggest struggles for the WDFW was a gap in understanding the human dimensions of wolf recovery. The ecological recovery of wolves may be progressing, but increasing efforts will need to be made to understand and work within the social constraints of wolf management. Overall, there is a marked lack of trust between the management agencies, conservation groups, and livestock producers in Washington. Dr. Bruskotter's research on the importance of elite cues in identity conflicts may be helpful in informing efforts to address this issue and foster coexistence. For example, the use of lethal control and lack of mandatory use of non-lethal control against wolves prior to depredations may send cues to the livestock producers that lethal control is efficient and endorsed. In contrast, efforts by state agencies to translocate problem animals (e.g. black bears) instead of shooting them could send cues to the public that the species being moved is important and wanted in the backcountry.

Most of the panelists highlighted the necessity of trust between the management agencies and the general public, stressing one-on-one efforts to build relationships, being transparent, and decreasing polarization by focusing on common goals. Both Dr. Bruskotter and Dr. Treves mentioned the importance of talking about the potential benefits of carnivores and reframing the ongoing conflict. Right now, much of the general public, as well as some natural resource managers, are asking the question, "How do we live with animals that can kill us and the things we value?" It may be that the way to move forward is to instead focus on the potential positives associated with wolves, and other carnivores, rather than on the conflict they can create. The current frame surrounding carnivore management suggests a rational approach to dealing with animals, but it seems that our behavior is at least partially determined by our emotions. Additionally, a new frame and perspective may create spaces of common ground to promote conflict resolution between traditionally opposed groups (Asah et al., 2012). Because wildlife is a public resource, it is also important for management to focus on all the legal uses of wildlife and preserve natural resources for future generations.

## Summary

Lethal removal can disrupt wolf pack dynamics, inhibiting recovery objectives in recolonizing populations, potentially increase livestock depredation, and negatively affect human attitudes towards wolves (Brainerd et al., 2008; Borg et al., 2015; Wielgus and Peebles, 2014; Treves et al., 2009; Treves and Bruskotter, 2014). Thus, understanding the effects of lethal control in Washington State will require rigorous ecological and social science research of the kind presented at this panel discussion. Based on the information provided, it seems that Washington State could benefit from the construction of a risk map for increased precision in targeting potential problem areas for wolf depredations (Treves et al., 2011). Furthermore, human dimensions research on wolf recovery in Washington State is needed in order to gain a more nuanced understanding of the ways in which individuals and groups are viewing wolves and the potential reasons behind those perceptions. Stakeholders must play an integral part of wolf management. Trust and relationship building efforts between all the stakeholders is critical; transparency in management is necessary. The results from the panel show that the needs of recolonizing and isolated wolf packs must be carefully assessed when considering lethal removal. In order to implement the best available science, we must know more about the effectiveness of various preventative measures, the habits and trends of wolves within Washington, and the needs and desires of the people involved.



## Cited Sources:

1. Asah, Stanley T., Bengston, David N., Wendt, Keith, Nelson, and Kristen C. (2012). Diagnostic Reframing of Intractable Environmental Problems: Case of a Contested Multiparty Public Land-use Conflict. *Journal of Environmental Management*. 108, 108-119.
2. Brainerd, S. M., Andrén, H., Bangs, E. E., Bradley, E. H., Fontaine, J. A., Hall, W., Iliopoulos, Y., Jimenez, M. D., Jozwiak, E. A., Liberg, O., Mack, C. M., Meier, T. J., Niemeyer, C. C., Pedersen, H. C., Sand, H., Schultz, R. N., Smith, D. W., Wabakken, P., and Wydeven, A. P. (2008). The Effects of Breeder Loss on Wolves. *Journal of Wildlife Management*. 72, 89-98.
3. Borg, L. B., Brainerd, M. S., Meier T.J., and Prugh R. L. (2015). Impacts of Breeder Loss on Social Structure, Reproduction and Population Growth in a Social Canid. *Journal of Animal Ecology*. 84(1), 177-187.
4. Bruskotter T. J. (2013). The Pendulum Revisited: Social Conflict over Wolves and their Management in the Western United States. *Wildlife Society Bulletin*. 37(3), 674-679.
5. Bruskotter T. J., Schmidt R. H., and Teel T. L. (2007). Are Attitudes toward Wolves Changing? A Case Study in Utah. *Biological Conservation*. 139, 211-218.
6. Dickman, A. J. (2010). Complexities of conflict: the importance of considering social factors for effectively resolving human-wildlife conflict. *Animal Conservation*, 13, 5, 458-466.
7. Dietsch A. M. Teel, T. L., Manfredo, M. J., Jonker, S.A., and Pozzanghera S. (2011). State report for Washington from the research project entitled "Understanding People in Places." Project report for the Washington Department of Fish and Wildlife. Fort Collins, CO: Colorado State University, Department of Human Dimensions of Natural Resources.
8. Hogberg, J., Treves, A., Shaw B., and Naughton-Treves, L. (2013). Attitudes Toward Wolves Since the First Regulated Wolf Hunting and Trapping Season in Wisconsin. *Institute for Journalism and Natural Resources*. Iron Mountain, MI.
9. Kellert, S. R. (1978). Attitudes and Characteristics of Hunters and Anti-hunters. *Transactions of the North American Wildlife and Natural Resources Conference* 43, 412-423.
10. Lute, M.L., Bump, A., and Gore, M.L. (2014). Identity-Driven Differences in Stakeholder Concerns about Hunting Wolves. *PLoS ONE* 9(12), e114460.
11. MacNulty, D. R., Smith, D. W., Mech, D. L., Vucetich A. J., and Packer, C. (2012). Nonlinear Effects of Group Size on the Success of Wolves Hunting Elk. *Behavioral Ecology*. 23(1), 75-82.

12. MacNulty, D. R., Smith, D. W., Mech, D.L., and Eberly, L. E. (2009) Body Size and Predatory Performance in Wolves: Is Bigger Better? *Journal of Animal Ecology*. 78, 532-539.
13. Mech, D.L. (1994). Buffer Zones of Territories of Gray Wolves as Regions of Intraspecific Strife. *Journal of Mammology*. (75)1, 199-202.
14. ----- (1999). Alpha Status, Dominance, and Division of Labor in Wolf Packs. *Canadian Journal of Zoology*. (77)8, 1196-1203.
15. Naughton-Treves, L., Grossberg, R., and Treves, A. (2003). Paying for tolerance: The Impact of Livestock Depredation and Compensation Payments on Rural Citizens' Attitudes toward Wolves. *Conservation Biology*. 17, 1500-1511.
16. Ordiz, A., Bischof, R., and Swenson, J. E. (2013). Saving Large Carnivores, but Losing the Apex Predator? *Biological Conservation*. 168, 128-133.
17. Oregon Department of Fish and Wildlife (2005, updated 2010). Oregon Wolf Conservation and Management Plan. Salem, OR.
18. Oregon Fish and Wildlife (2013). Wolf Lethal Take Rules in Oregon. Livestock Producer Reference. Salem, OR.
19. Responsive Management (2014). Washington Residents' Opinions on Bear and Wolf Management and Their Experiences with Wildlife that Cause Problems. *A study conducted for the Washington Department of Fish and Wildlife*. Olympia, WA.
20. Slagle, K. M., Bruskotter, J.T., and Wilson S. R. (2012). The Role of Affect in Public Support and Opposition to Wolf Management. *Human Dimensions of Wildlife: an International Journal*. 17(1), 44-57.
21. Treves A. and Bruskotter J. T. (2014). Tolerance for Predatory Wildlife. *Science*. 344, 476-477.
22. Treves A, and Karanth, K. U. (2003). Human-carnivore Conflict and Perspectives on Carnivore Management Worldwide. *Conservation Biology*. (17)6, 1491-1499.
23. Treves, A., Jurewicz, R., Naughton-Treves, L., and Wilcove, D. (2009). The Price of Tolerance: Wolf Damage Payments after Recovery. *Biodiversity and Conservation*. 18(14), 4003-4021.
24. Treves A., Martin A. K., Wydeven P.A., and Wiedenhoef E. J. (2011). Forecasting Environmental Hazards and the Application of Risk Maps to Predator Attacks on Livestock. *Bioscience*. 61, 451-458.
25. Treves, A., Vucetich, Cornman, and Mitchell (2013). Unpublished report to Michigan Natural Resources Committee available upon request.

26. Wallach, A. D., Ritchie, E. G., Read, J., and O'Neill, A. J. (2009). More than Mere Numbers: the Impact of Lethal Control on the Social Stability of a Top-Order Predator. *PLoS One*. 4(9), e6861.
27. Wielgus, R. B., and Peebles K. A. (2014). Effects of wolf mortality on livestock depredations. *PLoS ONE*. 9(12), e113505.
28. Wiles, G. J., Allen H. L., and Hayes G. E. (2011). Wolf Conservation and Management Plan for Washington Department of Fish and Wildlife. Olympia, WA.
29. (2013, January 1). Retrieved February 27, 2015, from <http://www.thewildlifeneeds.com/>
30. (2015, February 24). Retrieved February 27, 2015, from <http://www.dfw.state.or.us/wolves/>

Appendix:

Figure 1. WDFW decision process for implementing lethal control of wolves, Martorello, 2014.

### Wolf Conflict Management Flowchart

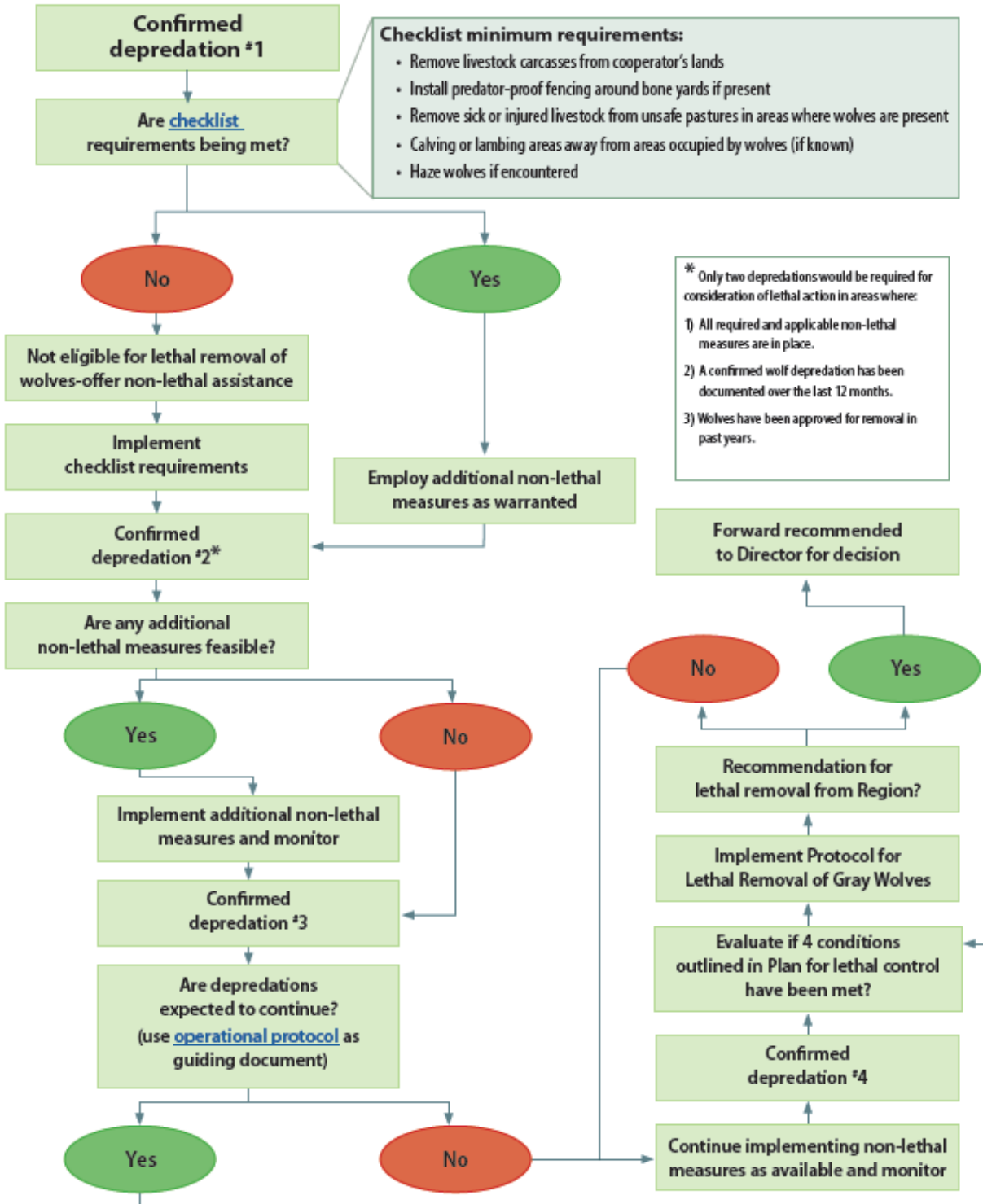


Figure 2. Washington confirmed wolf pack locations and corresponding conflict specialists, Martorello, 2014.

